Spicer® Drive Axles

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Service Manual

Spicer® Drive Axles

AXSM-8942

September 2007

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GENUINE SPICER SERVICE PARTS

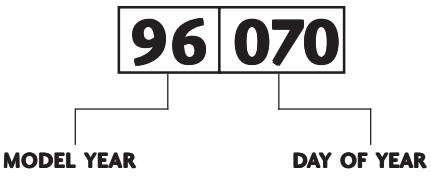
Should an axle assembly require replacement component parts, it is recommended that Spicer Heavy Axle Service Parts be used. Spicer Heavy Axle Service Parts are manufactured under the same rigid specification as are original equipment axle components. This assures the customer who uses genuine Spicer service parts, maximum reliability for a Spicer Heavy Axle assembly. They may be obtained through your vehicle manufacturer. The use of non-original Spicer service parts may cause premature component failure and may void the warranty.

The items included in this book are currently being offered as service parts at the time of printing. The part numbers and illustrations are provided specifically for reference purposes only. Therefore, Spicer reserves the right to update this manual without notice or liability.

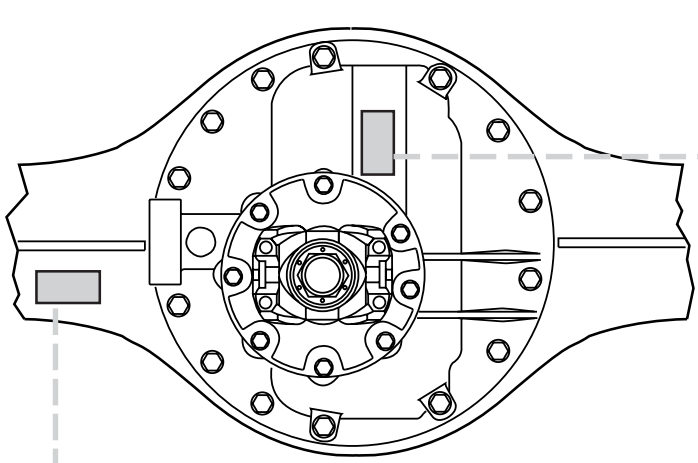
AXLE IDENTIFICATION

All axle assemblies are identified with two tags. One located on the differential carrier, and the other located on the right hand side of the axle housing.

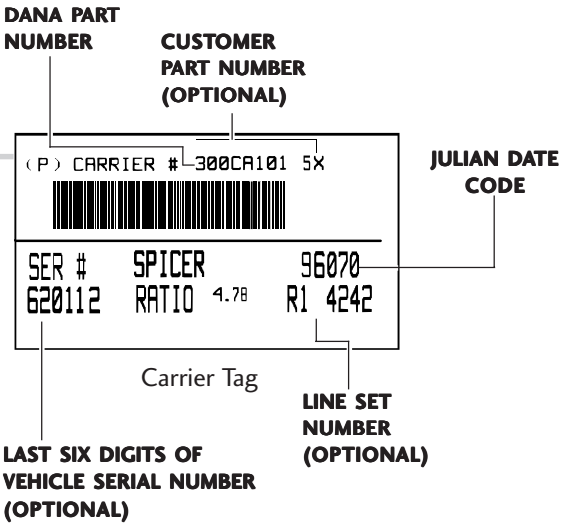
JULIAN DATE CODE

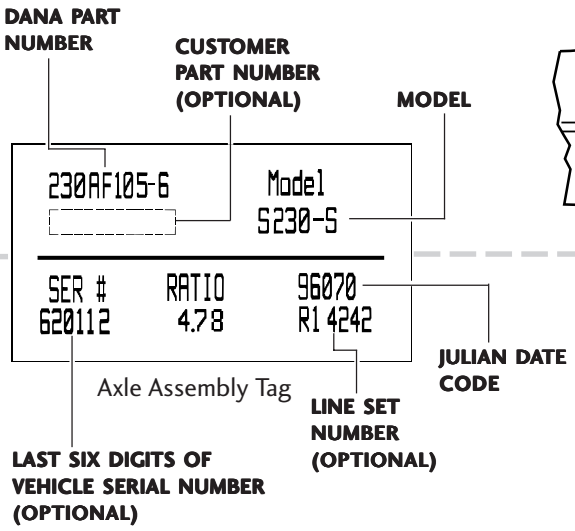


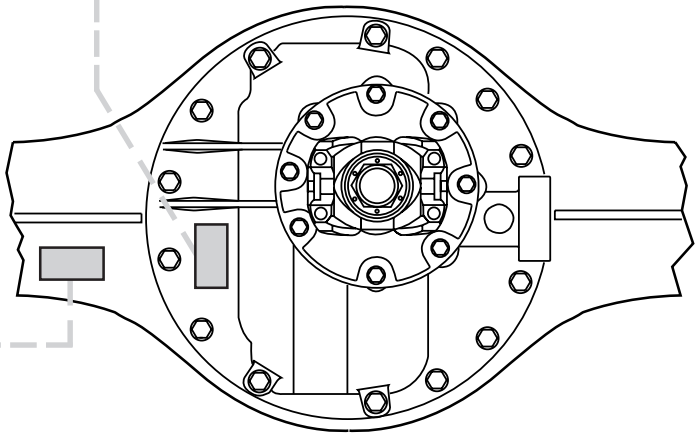
The **differential carrier tag** contains the following: Dana part number, julian date code, and ratio. Optional items include customer part number, line set number, and the last six digits of the vehicle serial number.



Pinion Below Center



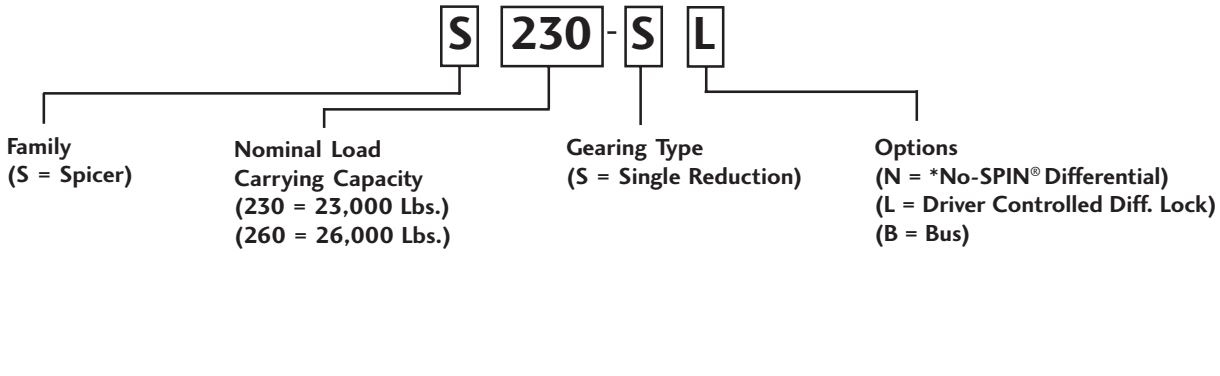




Pinion Above Center

The **axle assembly tag** contains the following items: Dana part number, julian date code, axle model, and ratio. Optional items include customer part number, line set number, and the last six digits of the vehicle serial number.

MODEL IDENTIFICATION NUMBERING SYSTEM



** No-SPIN® is a registered trademark of Tractech*

GEAR SET IDENTIFICATION

Manufacturer's Date- Date gear set was made.

Spicer Trademark- Company logo and location of manufacturing facility.

300GP203- Part number of pinion gear. (TYPICAL)

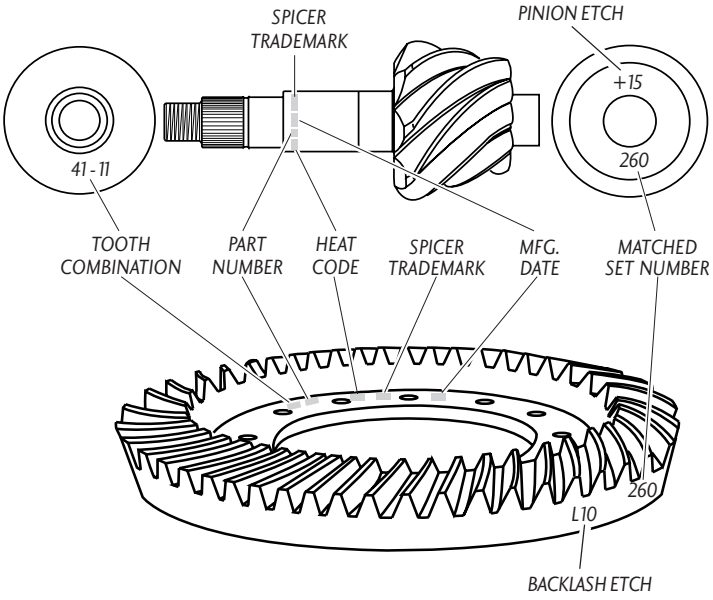
Tooth Combination(i.e. 41-11)- Indicates the pinion has 11 teeth and the ring gear has 41 teeth which results in a 3:73:1 ratio.

Matched Set Number- Spicer ring gears and pinions are manufactured as matched sets. Both ring gear and pinion are marked with a corresponding number (i.e. 260), which identifies them as a matched set.

A gear set that does not have the same match set numbers should not be run together. If either ring gear or pinion require replacement, a new matched set must be used.

Backlash Etch- Indicates backlash setting for assembly.

Pinion Etch- Indicator for proper pinion position shim stack up. **See Pinion Position Section.**



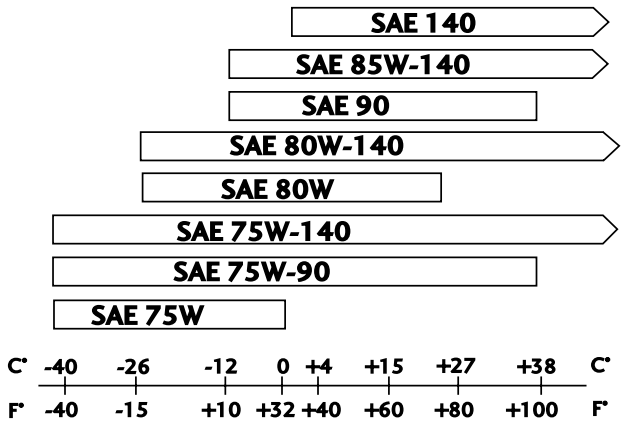
AXLE LUBRICANT RECOMENDATIONS

To ensure proper lubrication and operating temperature, correct lubricants and lubricant levels must be obtained.

RECOMMENDED GEAR LUBRICANTS

Mineral or Synthetic based hypoid gear lubricants that meet or exceed military specification MIL-L-2105D, and API service classification GL-5, are the minimum requirements for use in Spicer Medium and Heavy Duty Drive Axles.

The table below indicates which SAE viscosities are recommended for various temperature ranges the vehicle will encounter.



AMBIENT AIR TEMPERATURE

SERVICE

Recommended lubricant change intervals are dependent on the application and operating environment. The following chart should be used to establish proper change intervals.

SUBMERSION OR DEEP WATER FORDING

In the event the carrier housing should become submerged in water, particularly if over the vent or breather, it is recommended that the lubricant be drained and all internal parts be inspected for water damage and/or contamination. Reassemble the carrier to the housing and refill with specified gear lubricant.

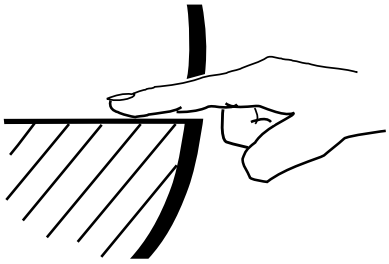
APPLICATION	PETROLEUM BASED		SYNTHETIC BASED**	
	MILES	INTERVAL	MILES	INTERVAL
On Highway	100,000	1 Year	250,000	3 Year
* Severe Service and On-Off Highway	50,000	1 Year	100,000	1 Year

* Severe service includes any applications operating at or near maximum GVW or GCW ratings. This includes normally wet or dusty environment, or consistent high load and low speed applications.

** Includes Semi-Synthetic blends that meet MIL-L-2105D specifications.

AFTER OVERHAUL OR CHANGE INTERVALS

Fill the axle assembly to the bottom of housing fill hole as shown in the illustration below. It is recommended that following an overhaul, each side of the axle be jacked up seperately to approximately six inches and held into position for one minute. This procedure will allow adequate lubricant to flow into the wheel ends and help eliminate the possibility of premature damage to wheel bearings and seals. Lower the vehicle to the floor and allow ten minutes for lube to return to normal level. Check and refill assembly to bottom of fill hole to replace the lubricant that was directed into the wheel ends.



NOTE: Lubricant close enough to the bottom of the fill hole to be seen or touched is not sufficient. Lubricant must be level with the fill hole.

GENERAL PRECAUTIONS

⚠ IMPORTANT

READ THIS SECTION BEFORE STARTING ANY SERVICE PROCEDURES

GENERAL AXLE DESCRIPTION

This manual covers maintenance and rebuild procedures for the Spicer S230-S, S230-SL, and S260-SB rear drive axle assemblies.

The Spicer Heavy Duty Single Reduction rear drive axle is a full floating axle assembly, with a hypoid gear carrier assembly, using a High Strength Low Alloy (HSLA) steel axle housing. The hypoid pinion is straddle mounted with two tapered roller bearings behind the pinion teeth for thrust and radial loads. A pilot bearing is located on the nose of the pinion for radial load. The differential itself uses four precision forged pinion mate gears, a forged cross, and precision forged side gears.

Safety glasses should be worn at all times when assembling or disassembling axles.

SAFTEY PRECAUTIONS

Proper service and repair of vehicle components is important to the safe and reliable operation of all motor vehicles. This applies particularly to driving axles such as the ones described in this manual. The procedures recommended and described in this manual are tested, effective methods for performing service operations. Follow each procedure closely, making use of both the text and illustrations. Some of these service procedures show the use of certain tools designed specifically for the operation being performed. They are shown as a preferred means of performing the operation. It is not practical to anticipate and advise the service trade of all possible alternative methods, and of all possible hazardous consequences that could occur.

Accordingly, anyone who uses a service procedure or tool different than shown must insure that their safety, and the vehicle's safety, will not be jeopardized by the service method selected.

END YOKES AND FLANGES

⚠ **CAUTION: Hammering on end yokes can close in the bearing bores or misalign yoke lugs and result in early failures of journal needle bearings or other driveline components. Serious damage can also be done internally to the ring and pinion set or pinion bearings by hammering on external parts. End yokes or companion flanges should be removed or installed using the recommended methods outlined in this manual.**

CLEANLINESS

Axle components should be steam cleaned prior to removal from the vehicle. Dirt is abrasive and will cause premature wear of otherwise serviceable parts.
Service personnel should use a wash tank for thorough cleaning of parts just prior to reassembly.

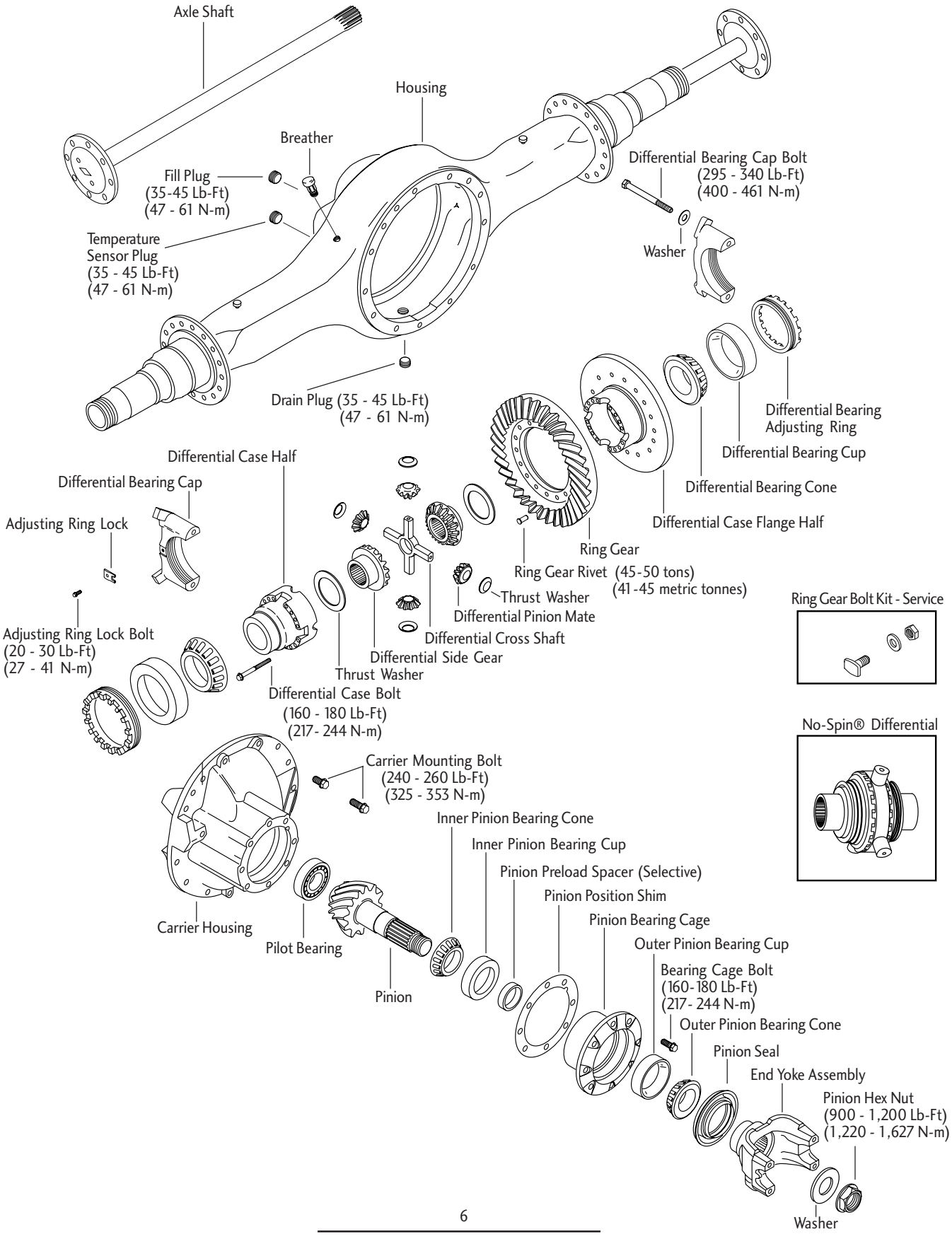
⚠ CAUTION

BRAKE LININGS CONTAIN NON-ASBESTOS FIBERS

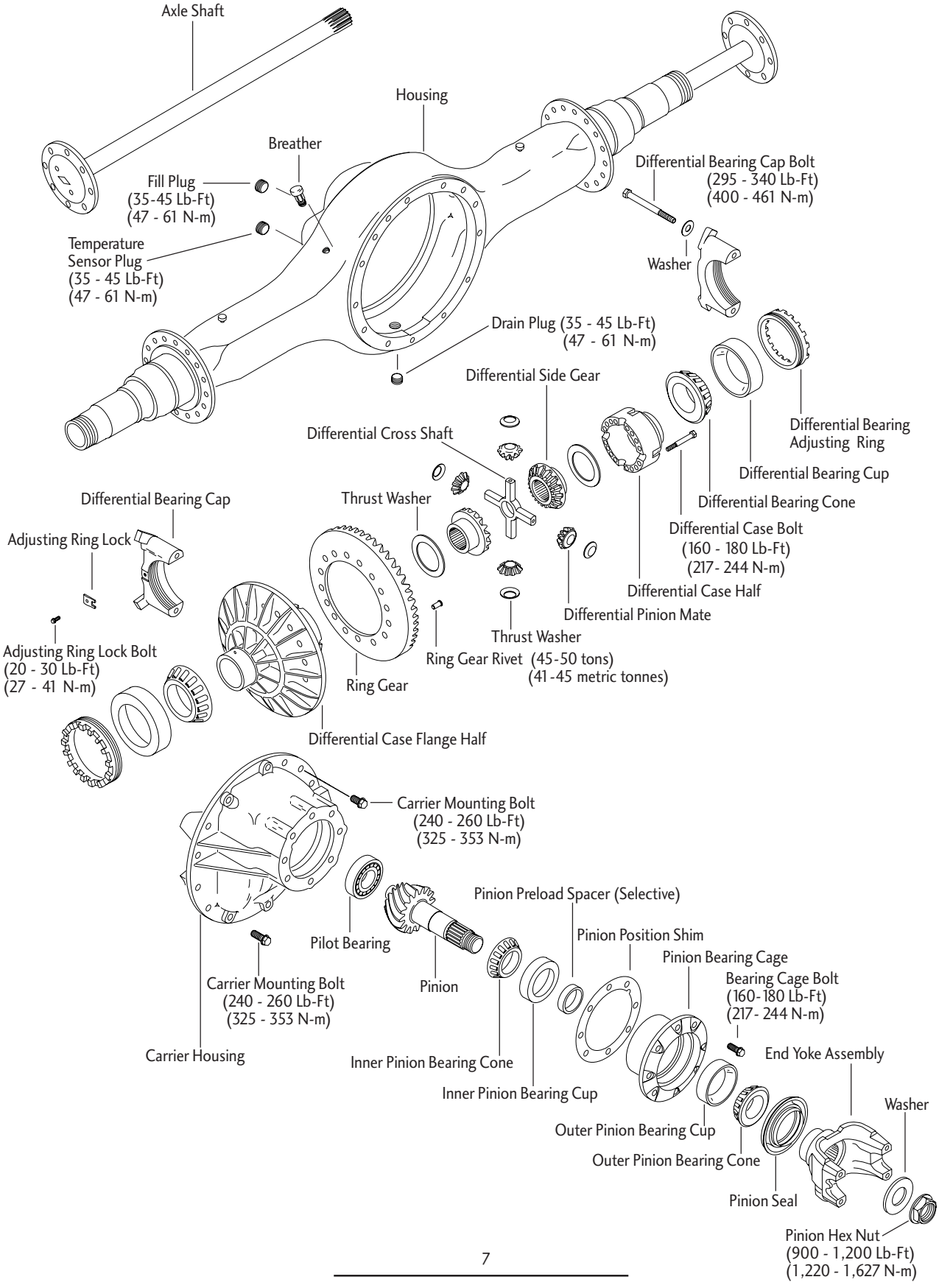
BREATHING BRAKE DUST MAY BE HAZARDOUS TO YOUR HEALTH AND MAY CAUSE SERIOUS RESPIRATORY OR OTHER BODILY HARM.

AVOID CREATING DUST
DO NOT REMOVE BRAKE DRUM WITHOUT PROPER PROTECTIVE EQUIPMENT.
DO NOT WORK ON LININGS WITHOUT PROPER PROTECTIVE EQUIPMENT.
DO NOT REPLACE LININGS WITHOUT PROPER PROTECTIVE EQUIPMENT.
DO NOT ATTEMPT TO SAND, GRIND, CHISEL, FILE, HAMMER OR ALTER BRAKE LININGS IN ANY MANNER WITHOUT PROPER PROTECTIVE EQUIPMENT.
FOLLOW O.S.H.A. STANDARDS FOR PROPER PROTECTIVE DEVICES TO BE USED WHEN WORKING WITH BRAKE MATERIALS.

STANDARD AXLE COMPONENTS



PINION-UP AXLE COMPONENTS



REMOVAL OF DIFFERENTIAL CARRIER FROM AXLE HOUSING

IMPORTANT: If the vehicle is equipped with driver controlled differential lock, see instructions begining on page 24. To tow a vehicle with driver controlled differential lock, see instructions on page 26.

NOTE: Steam clean axle assembly.

1. Block wheels.
2. Remove axle housing drain plug and drain lubricant.
3. Disconnect drive shafts at the rear U-joint.

NOTE: If end yoke and/or seal is to be replaced, loosen yoke nut at this time.

4. Remove axle shaft flange nuts.
5. Hold a large brass drift or a brass hammer against the center of the axle shaft flange. Strike the drift with sharp blows from a large hammer or sledge until the axle shaft separates from the hub.

⚠ CAUTION: Do not strike the flange directly with a steel hammer or sledge. This may crack and splinter material, possibly causing serious or fatal injury. Do not pry or chisel axle flange away from hub or damage to sealing surfaces could occur.

6. Remove axle shafts.
7. Support the differential carrier assembly on a roller jack. Secure as necessary to prevent it from falling off the jack when removed from the housing.
8. Use a breaker bar to loosen the differential carrier-to-housing mounting bolts. Remove all bolts except top two. These two bolts will prevent the carrier assembly from falling.
9. Separate differential carrier from the housing using removal slots. **See Figure 1.** Be certain carrier is balanced properly on jack, and remove top two carrier-to-housing mounting bolts. Remove differential carrier assembly from the axle housing.

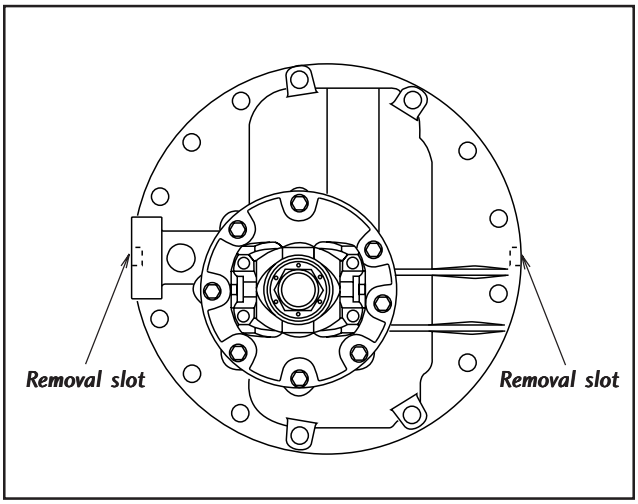


Figure 1

10. Mount carrier assembly in a suitable rebuild stand. (Refer to **Recommended Service Tools**, pg. 32).

Differential Carrier Removal Complete

REMOVAL OF DIFFERENTIAL FROM CARRIER

1. Remove adjusting ring locks from bearing caps.
2. Match mark one differential bearing cap and leg with center punch or chisel for correct reassembly. **See Figure 2.**

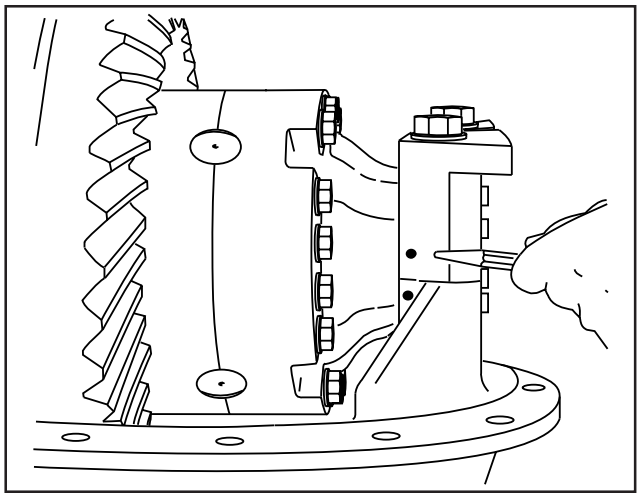
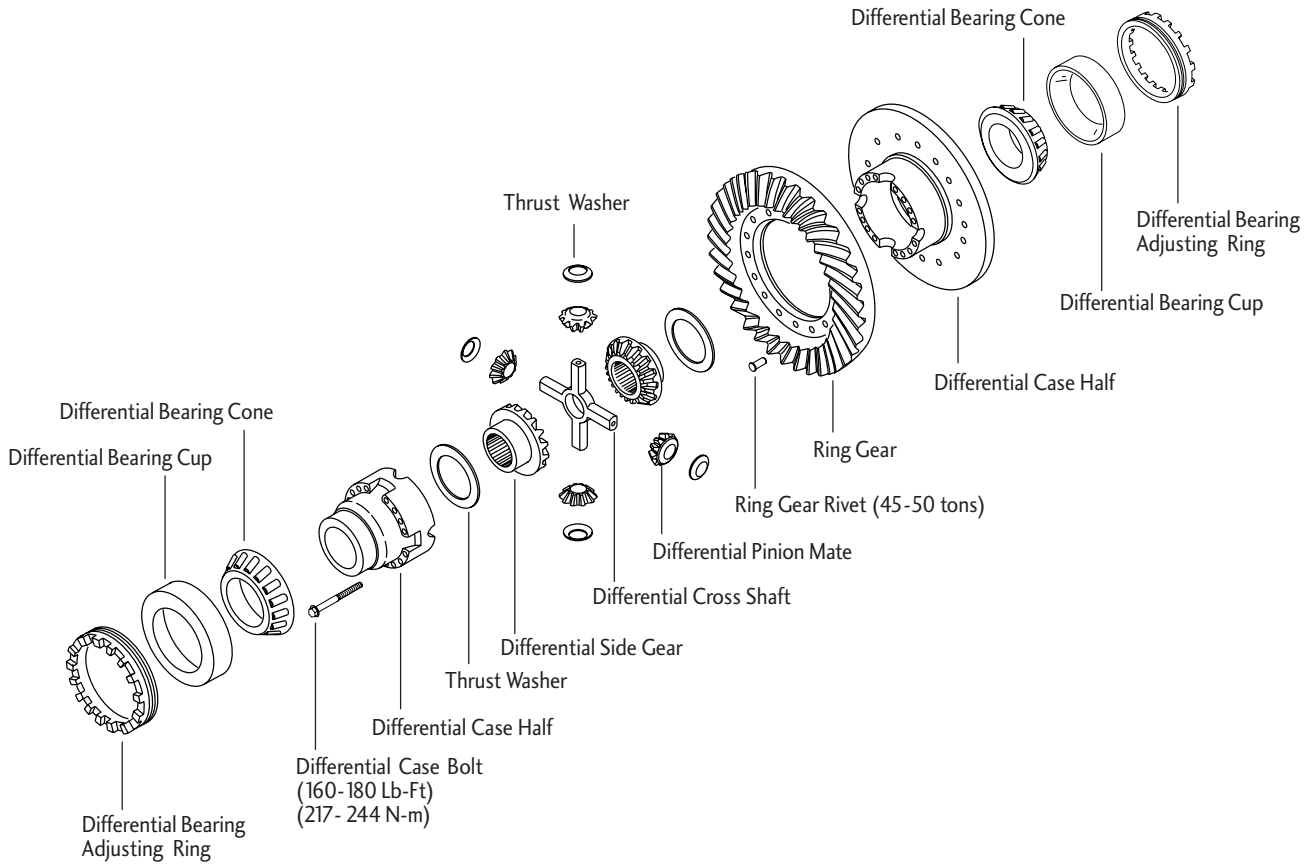


Figure 2

3. Loosen four bearing cap retainer bolts.
4. Loosen adjusting rings, relieving bearing preload.
5. Remove four bearing cap retainer bolts.
6. Remove bearing caps.
7. Remove adjusting rings.
8. Carefully lift the ring gear and differential subassembly out of the carrier.

NOTE: Use care not to damage the ring gear and pinion. If either ring gear or pinion show signs of damage, they must be replaced as a matched set.

Removal of Differential Complete



1. Match mark differential case halfs with punch or chisel for correct alignment in reassembly.
   See Figure 3.

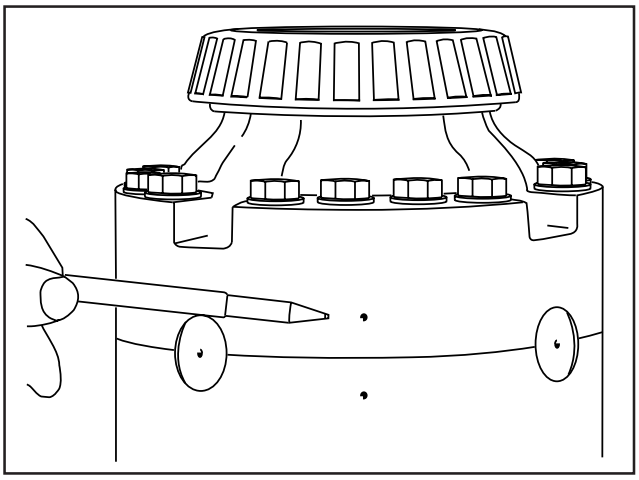


Figure 3

2. Remove differential case bolts and lift off differential case half.
3. Remove thrust washer and differential side gear.
4. Lift out cross shaft, pinion mates, and thrust washers.
5. Remove second differential side gear and thrust washer.
6. If differential side bearings are to be replaced, remove old bearings using a suitable puller.
   See Figure 4.

DIFFERENTIAL DISASSEMBLY

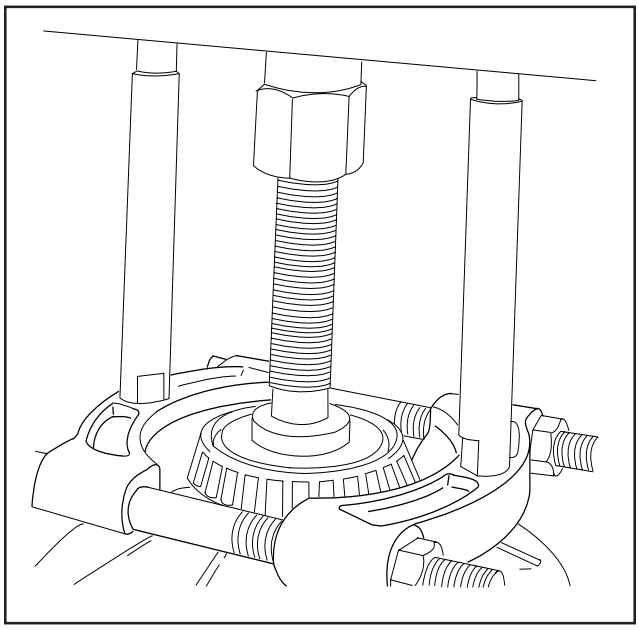


Figure 4

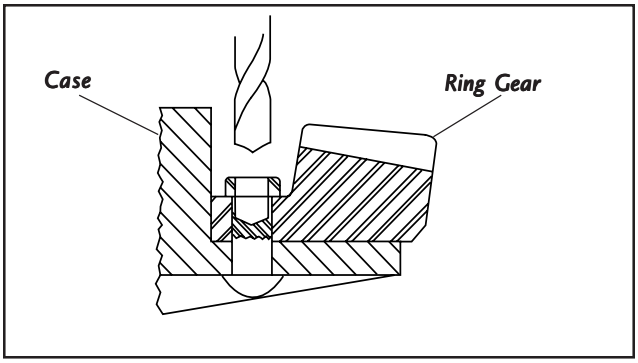
NOTE: Inspect all parts, including the machined surfaces of the case half.

If any gears are to be replaced, they must be replaced in matched sets. Inspect thrust washers for scoring and excessive wear. Replace all worn or damaged parts.

NOTE: Ring gear bolt kits are available as a replacement for ring gear rivets, see Parts List manual for part number information.

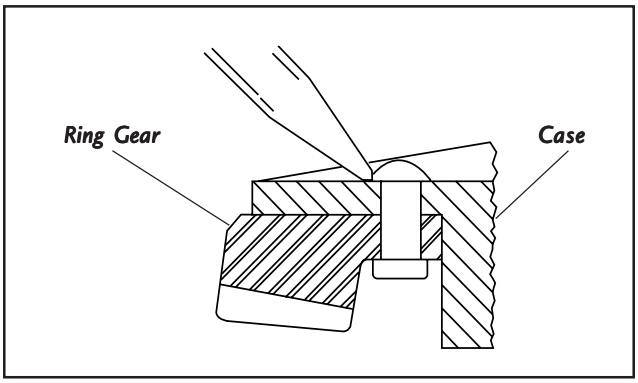
7. When it is necessary to remove ring gear from the differential case, carefully center punch each rivet head. Use a 9/16 inch drill bit. Drill through rivet heads to depth shown. Next, use a rounded type punch to drive out remaining portion of the rivet.

CORRECT PROCEDURE



⚠ CAUTION: Always use a soft hammer or H.D. plastic head hammer to strike punch.

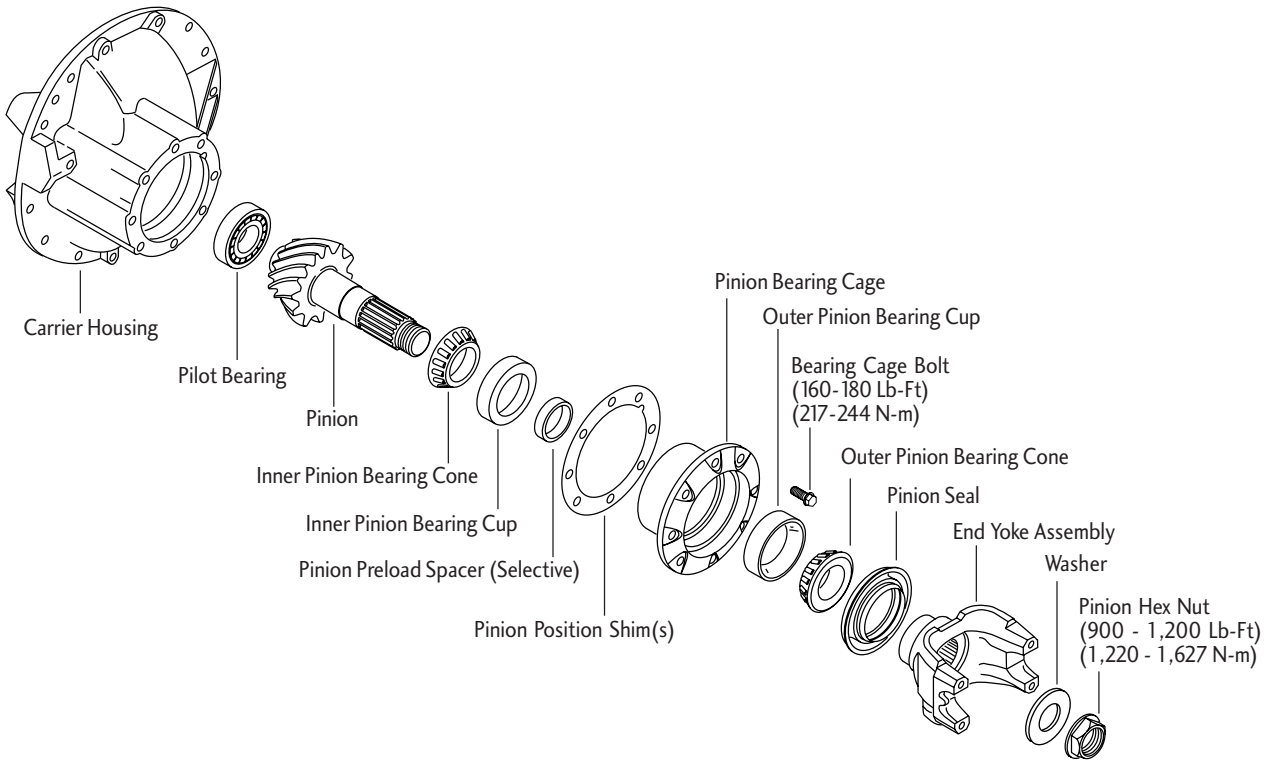
INCORRECT PROCEDURE



NOTE: Do not use a chisel to remove rivet heads, damage to differential case may result.

Differential Disassembly Complete

PINION DISASSEMBLY



1. Remove pinion bearing cage mounting bolts.
2. Remove pinion assembly from carrier housing. If difficulty is encountered in removing pinion assembly from carrier housing, place a brass drift on inner end of pinion and tap lightly with hammer.

NOTE: Retain shims for possible use during reassembly.

3. Hold yoke stationary. Remove nut and washer. A torque multiplier may be required to loosen nut.
4. Remove the end yoke using a suitable puller. See **Recommended Service Tools**, pg. 32.
5. Remove pinion from cage assembly.

NOTE: It may be necessary to tap outer end of pinion with a soft hammer, taking care not to damage threads.

6. Located between the pinion bearings is a selective bearing preload spacer. Retain this selective preload spacer for possible use during reassembly.
7. Remove the old pinion seal and discard. Always use a new seal at the time of reassembly.
8. Lift out the outer pinion bearing cone.
9. Remove inner pinion bearing cup, using a suitable adapter and press or puller.

⚠ **CAUTION: Do not nick bearing bore.**

10. Remove the outer pinion bearing cup, use the same procedure as in step 9.
11. Remove pilot bearing from end of pinion.
12. Remove inner bearing cone from pinion.

Pinion Disassembly Complete

CLEANING AND INSPECTION

CLEANING

1. Parts should be cleaned with emulsion cleaners or petroleum base cleaning solvent.

NOTE: Alkaline type solutions may cause damage to machined surfaces and should be avoided.

2. Make sure interior of axle housing is clean prior to reassembly.
3. Clean all gasket surfaces of old material.

DRYING

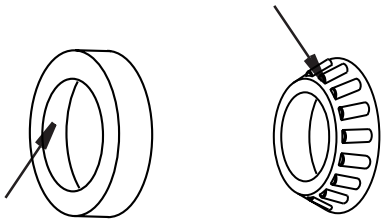
Use soft, clean, lintless towels or rags to dry components after cleaning. Bearings should NOT be dried by spinning with compressed air. This can damage mating surfaces due to the lack of lubrication.

After drying, parts should be coated with a light coat of lubricant or rust inhibitor to prevent damage from corrosion. If parts are to be stored for a prolonged period, they should be wrapped in wax paper.

INSPECTION

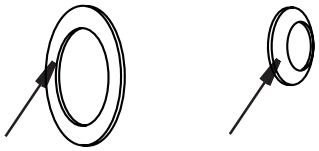
Prior to reassembly, inspect parts for signs of excessive wear or damage. Replacement of these parts can prevent premature failure and costly downtime.

BEARINGS



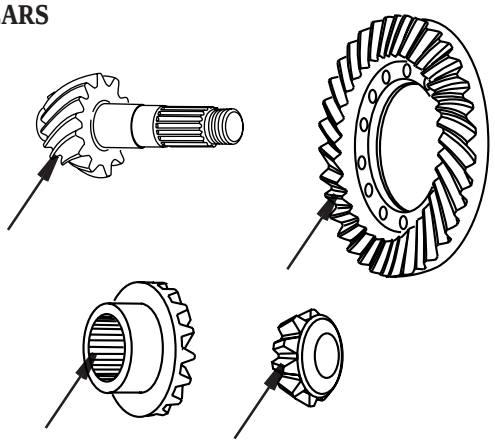
Bearing surfaces should be inspected for pitting, excessive wear, or overheating.

THRUST WASHERS



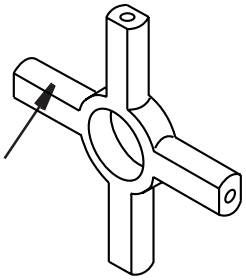
Inspect thrust washers for scoring and cracking.

GEARS



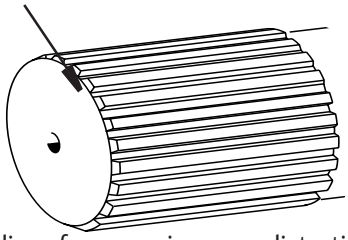
Inspect gears for excessive wear or damage. Replace gears that are pitted, scored, broken, or worn.

SHAFTS



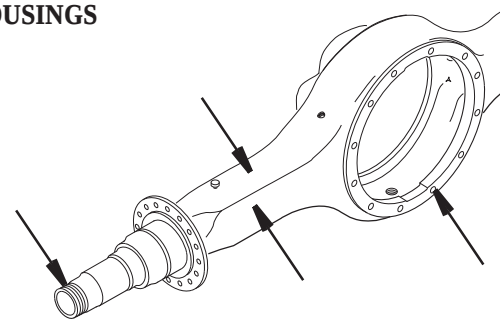
Inspect shafts for nicks or scoring.

SPLINES

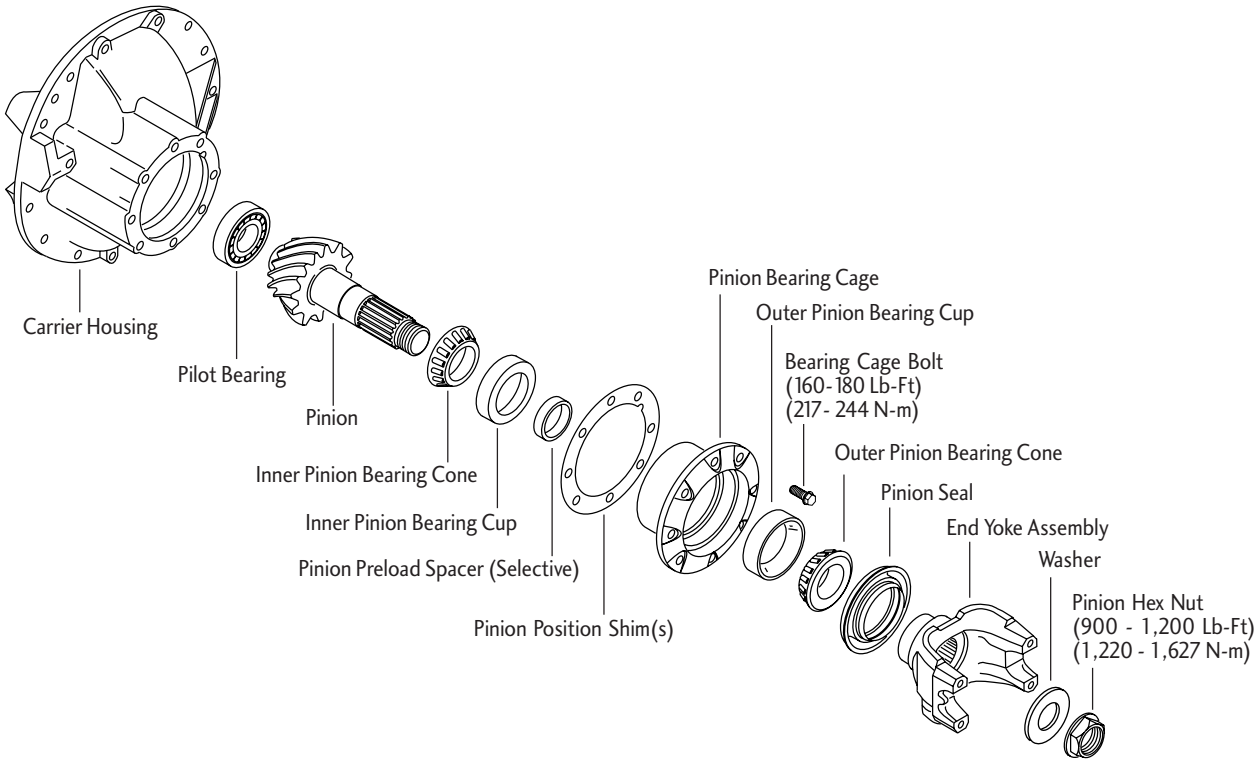


Inspect all splines for excessive wear, distortion from twisting, and cracking.

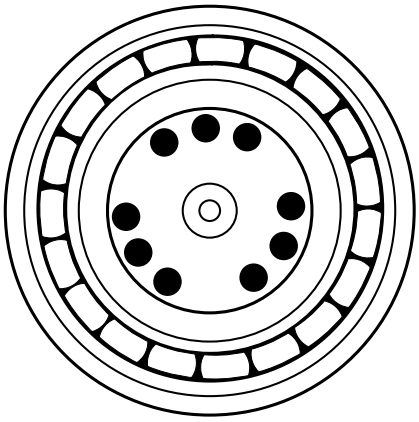
HOUSINGS



Inspect housing for stripped threads and bending fatigue.



1. Press inner pinion bearing cone onto pinion.
2. Press Pilot bearing onto the pinion.
3. Stake Pilot bearing in nine places (See illustration below), using a center punch or equivalent tool. This operation will move gear shaft material outward into bearing chamfer.



4. Install inner pinion bearing cup into pinion bearing cage.
5. Install outer pinion bearing cup into pinion bearing cage.
6. Use a feeler gauge or shim stock (.002 in. Max.) to ensure bearing cups are completely seated in bearing bores. This is necessary for the proper pinion position. **See Figure 5.**

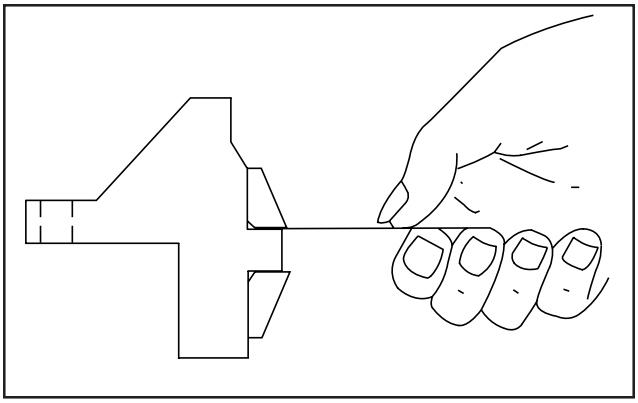


Figure 5

7. Place the selective preload spacer, that was removed during disassembly, onto pinion.

PINION ASSEMBLY

8. Place pinion bearing cage onto inner pinion bearing.
9. Install the outer pinion bearing cone onto pinion.
10. Without installing seal, install end yoke onto pinion using yoke installer service tool. **See Figure 6.** This will allow proper setting of pinion preload. Secure yoke with a Yoke and Flange Holding Bar or an equivalent tool. Install pinion nut and washer. Torque pinion nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

NOTE: Inspect end yoke seal surface for grooves caused by lip of seal. If grooves can be detected with fingernail, it should be replaced.

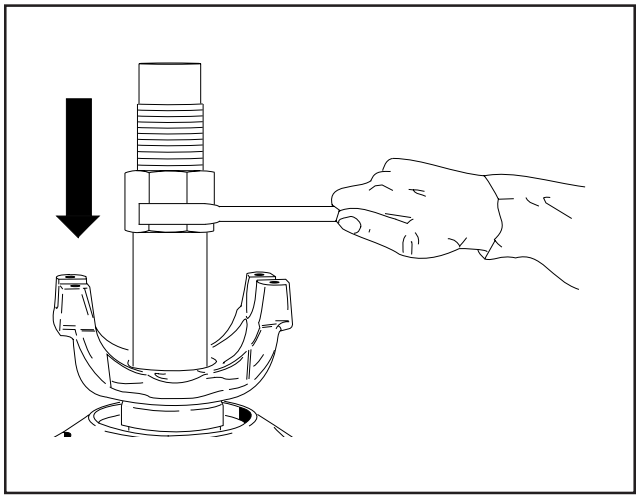


Figure 6

⚠ CAUTION: The pinion cage should be rotated periodically while tightening the pinion nut to seat and align the pinion bearings.

There are two methods of measuring pinion bearing preload and both are acceptable. Mechanic's preference and available tools should determine which method is used.

Method A uses a pull scale and a strong cord approximately 8 ft. long. (See Item 11). **Method B** uses a Lb-in torque wrench. Both methods measure torque to rotate. (See Item 12).

11. **Method A:** To measure torque-to-rotate with the spring scale, clamp the end yoke horizontally in a soft-jawed vise. Attach one end of the cord to a bolt hole in the pinion cage, wrap cord around pinion cage and attach the outer end of the cord to the spring scale. Rotate pinion cage by pulling scale. Read scale during fourth revolution. Scale reading must be between 3-10 Lbs (1.4-4.5 Kg) **See Figure 7.**

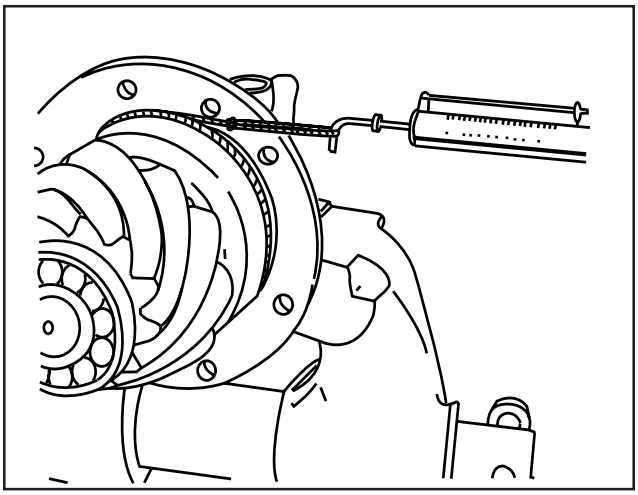


Figure 7

(Continued on Next Page)

12. **Method B:** To measure torque to rotate with the torque wrench, assemble pinion cage into the carrier housing and install two mounting bolts to anchor the unit.

Rotate pinion with the torque wrench. **See Figure 8**. Torque measurement will be taken during fourth revolution and must be between 10-40 Lb-in (1.1-4.5 N-m) without pinion seal.

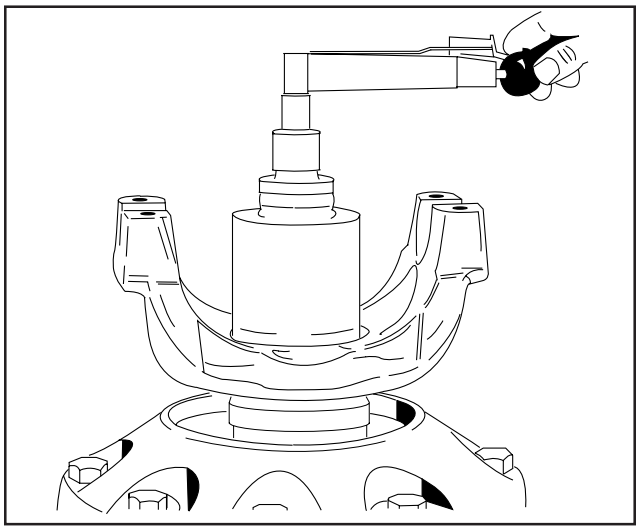


Figure 8

NOTE: When torque to rotate reading does not fall within allowable limits, bearing preload can be increased by using a thinner spacer or decreased by using a thicker spacer. .001 in. (.025 mm) change in preload spacer thickness, changes scale reading by approximately 10 lbs, .001 in. change in preload spacer will change torque to rotate by approximately 30 Lb- in. This is only a guide, individual carriers may vary slightly.

The pinion bearing spacers are available in the following thicknesses. Measure spacer with micrometers before assembly to ensure correct thickness.

Inches	MM
.893	22.982
.894	22.708
.895	22.733
.896	22.758
.897	22.784
.898	22.809
.899	22.835
.900	22.860
.901	22.885
.902	22.911
.903	22.936
.904	22.962
.905	22.987
.906	23.012
.907	23.038
.908	23.063
.909	23.089
.910	23.114
.911	23.139
.916	23.266

NOTE: Closer adjustment can be made by sanding next thicker spacer to desired thickness using emery cloth on a flat surface. Surfaces must be parallel to each other and square to bore diameter.

⚠ **CAUTION: Wash spacer thoroughly of emery cuttings before installing on pinion.**

14. After proper torque to rotate is achieved remove end yoke.

15. Clean and dry threads on pinion.

16. Install pinion oil seal with **Recommended Service Tool**. See page 32.

17. Install end yoke using yoke installer service tool DST1007. **See Figure 6.**

18. Coat threads with Loctite #680 adhesive compound.

(Continued on Next Page)

PINION POSITION

19. Install pinion nut and washer. Use torque multiplier and torque pinion nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

Pinion assembly is now ready to be installed into carrier housing.

Pinion Assembly Complete

Ring gears and pinions are supplied in matched sets only. Matching numbers on both the pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring gear before proceeding with assembly.

When a new gear set is being installed, use a micrometer to measure the thickness of the old pinion position shims. Measure each shim separately and add together to get the total thickness of the original build-up.

NOTE: If old shims are bent or mutilated they should be replaced.

If a new gear set is being used, notice the (+), (–) or "0" etching on both the old and the new pinions, and adjust the thickness of the shims to compensate for the difference of these two figures (as shown in table on next page).

For example, if the old pinion is etched +2, and the new pinion is –2, subtract .004 in. from the thickness of the original shims used to position the pinion.

If either or both the pinion gears are etched beyond the values on this chart, follow the same procedure to establish correct pinion position.

For example if the old pinion is etched –12 and the new pinion is etched +9, add .021 inch to the thickness of the original shims.

After determining the new total build up of pinion position shims, round the figure off to the nearest multiple of .005 inch.

Use the Pinion Setting Chart on the next page as a guideline to set the pinion.

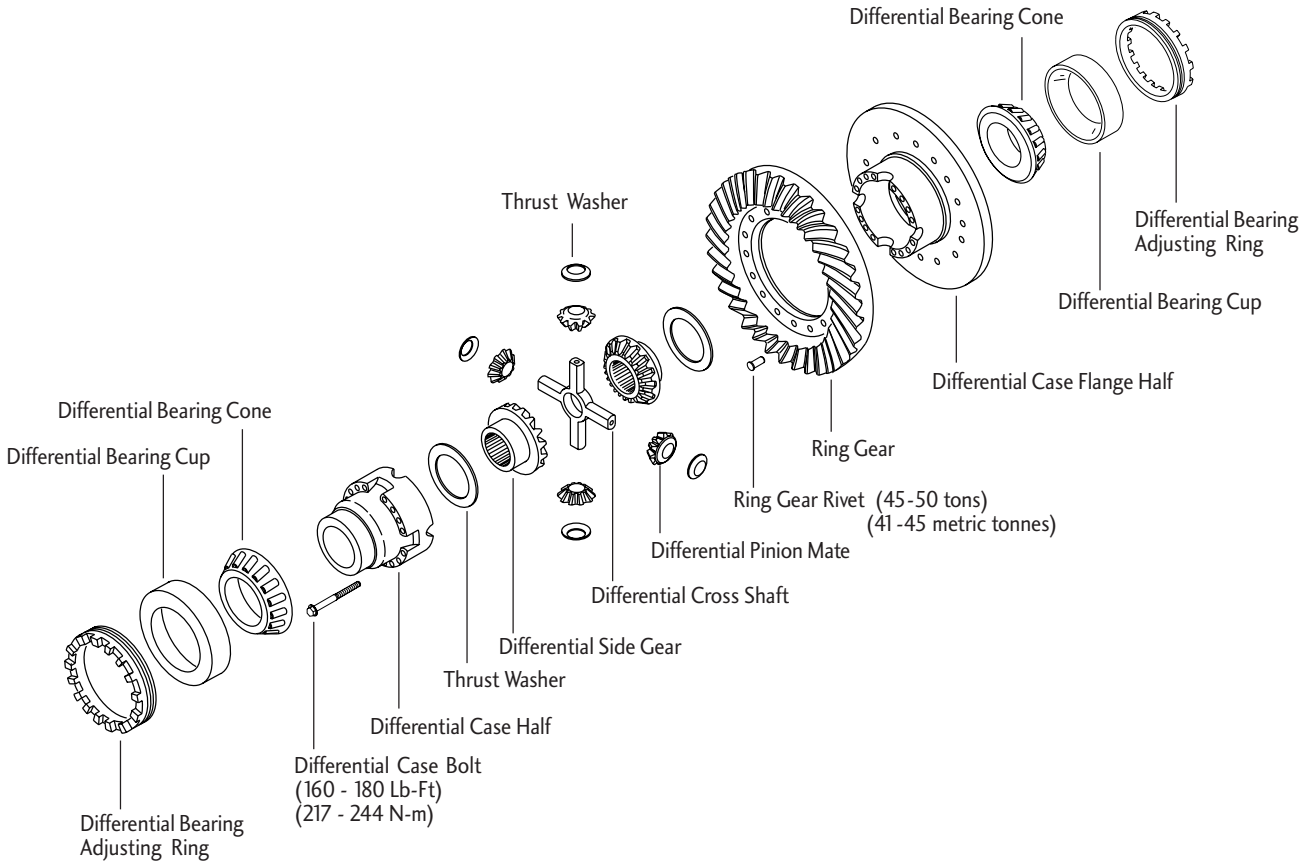
PINION SETTING CHART(OLD TO NEW PINION)

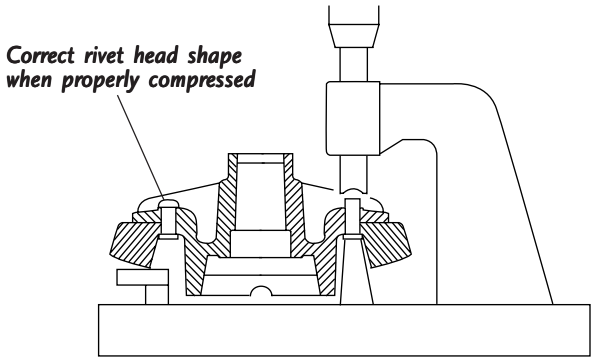
0.000 TOP(INCHES)
.000 BOTTOM(MM)

NEW PINION MARKING

OLD PINION MARKING	-10 M-25	-9 M-23	-8 M-20	-7 M-18	-6 M-15	-5 M-13	-4 M-10	-3 M-08	-2 M-05	-1 M-03	0	+1 M+03	+2 M+05	+3 M+08	+4 M+10	+5 M+13	+6 M+15	+7 M+18	+8 M+20	+9 M+23	+10 M+25
+10 M+25	-0.020 .508	-0.019 .483	-0.018 .457	-0.017 .432	-0.016 .406	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0
+9 M+23	-0.019 .483	-0.018 .457	-0.017 .432	-0.016 .406	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025
+8 M+20	-0.018 .457	-0.017 .432	-0.016 .406	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051
+7 M+18	-0.017 .432	-0.016 .406	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076
+6 M+15	-0.016 .406	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102
+5 M+13	-0.015 .381	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127
+4 M+10	-0.014 .356	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152
+3 M+08	-0.013 .330	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178
+2 M+05	-0.012 .305	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203
+1 M+03	-0.011 .279	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227
0	-0.010 .254	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.002 .051	+0.003 .076	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254
-1 M-03	-0.009 .227	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279
-2 M-05	-0.008 .203	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305
-3 M-08	-0.007 .178	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330
-4 M-10	-0.006 .152	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356
-5 M-13	-0.005 .127	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381
-6 M-15	-0.004 .102	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381	+0.016 .406
-7 M-18	-0.003 .076	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381	+0.016 .406	+0.017 .432
-8 M-20	-0.002 .051	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381	+0.016 .406	+0.017 .432	+0.018 .457
-9 M-23	-0.001 .025	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381	+0.016 .406	+0.017 .432	+0.018 .457	+0.019 .483
-10 M-25	0	+0.001 .025	+0.002 .051	+0.003 .076	+0.004 .102	+0.005 .127	+0.006 .152	+0.007 .178	+0.008 .203	+0.009 .227	+0.010 .254	+0.011 .279	+0.012 .305	+0.013 .330	+0.014 .356	+0.015 .381	+0.016 .406	+0.017 .432	+0.018 .457	+0.019 .483	+0.020 .508

DIFFERENTIAL ASSEMBLY





1. If ring gear was removed from the differential case, reinstall it at this time. Bolt ring gear to differential case in three places, 120° apart, before compressing rivet; this will eliminate ring gear runout. Use a hydraulic or mechanical press and riveting fixture. Pressure requirement per rivet is 45-50 U.S. tons or (41-45 metric tonnes).
2. Press bearing cones onto differential case halves. Place bearing cups on cones during remainder of assembly to prevent damage of bearings.

NOTE: Ring gear bolt kits are available as a replacement for ring gear rivets, see parts list manual for part number information.

3. Apply a small amount of gear lubricant to all mating surfaces. This will aid in assembly by keeping parts together and providing initial lubrication.
4. Place thrust washer and side gear in differential case flange half.
5. Assemble pinion mates and thrust washers onto differential cross shaft. Place assembly into flange half differential case.
6. Place remaining side gear and thrust washer in position on differential pinion mates.
7. Assemble case halves, making sure match marks are lined up.
8. If reinstalling used bolts, clean threads and apply Loctite #277. Install differential case bolts and torque evenly to 160-180 Lb-Ft (217- 244 N-m).

Differential Assembly Complete

1. Install ring gear and differential assembly into carrier housing.

CAUTION: To avoid damage of ring gear and pinion, care should be used when installing the ring gear differential assembly into the carrier housing.

2. Be sure side bearing cups are seated on bearing cones. Assemble differential bearing caps, with match marks in proper location. Clean bearing cap bolts and washers and coat threads with Loctite #277. Install bearing cap bolts and tighten enough to draw bolt head into contact with bearing cap, eliminating visible space between differential bearing cap and carrier housing. Do not torque the cap bolts at this time.

⚠ **CAUTION: Differential assembly must be aligned within bearing bores before preload is applied or damage to bearings can occur.**

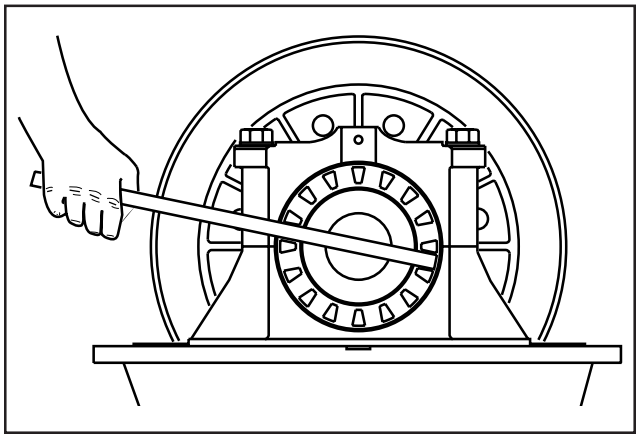


Figure 9

3. Install adjusting rings. Tighten both adjusting rings until end play is eliminated, and there is backlash between the ring gear and pinion. **See Figure 9.**

4. Loosen adjusting ring on tooth side of ring gear one notch and tighten adjusting ring on flange side of ring gear one notch. Repeat process until backlash is eliminated. Tighten adjusting ring on tooth side of the ring gear until the ring gear and pinion backlash matches the backlash etched on the ring gear. This adjustment sets both the backlash and the bearing preload.

5. Check ring gear and pinion backlash in four equally spaced positions around the ring gear with a dial indicator as shown. **See Figure 10. Acceptable backlash tolerance is +/- .002" from backlash etched on ring gear.**

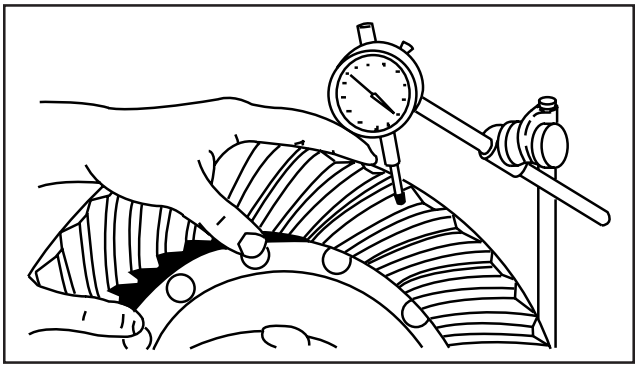


Figure 10

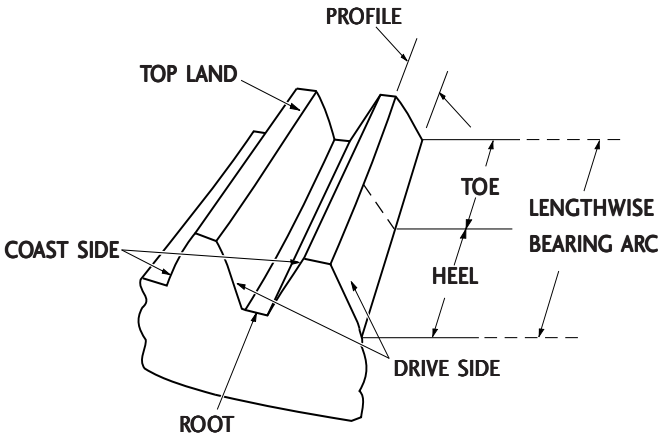
NOTE: If the backlash tolerance does not vary more than .004 in. (.080 mm), the setting is acceptable. If backlash does vary more than .004 in. (.080 mm), remove the differential and determine the cause.

6. Once backlash is set, torque the differential bearing cap bolts to 295-340 Lb-Ft (397-460 N-m). Check backlash after torquing cap bolts.

RING GEAR AND PINION TOOTH CONTACT PATTERN

The following procedures are to be used to establish proper gear tooth pattern after assembly of the carrier is complete.

NOTE: If matched sets are being reused, measure and record backlash before disassembly, and reassemble to the same backlash. This will match ring and pinion gears to the established wear patterns. Hand rolled patterns will cover less area than the gear pattern established by previous service.

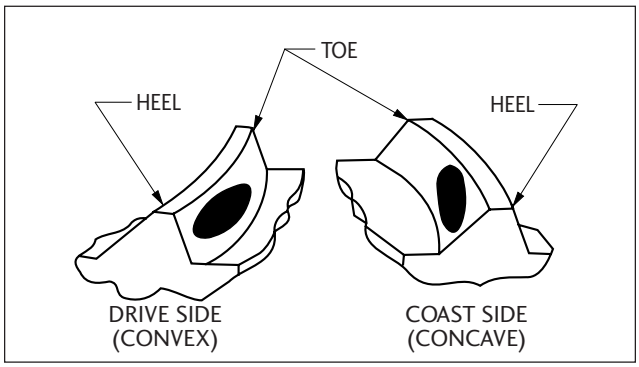


STEP 1. Paint 1/4 ring gear with marking compound on both the drive and coast side.

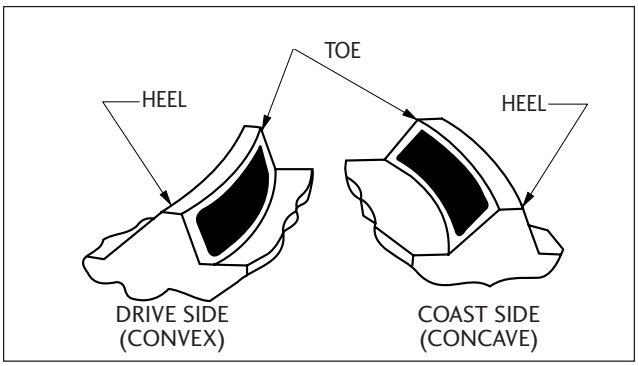
STEP 2. Apply drag load to ring gear and rotate pinion so that ring gear completes one revolution in each direction.

CORRECT GEAR PATTERNS

LIGHTLY LOADED

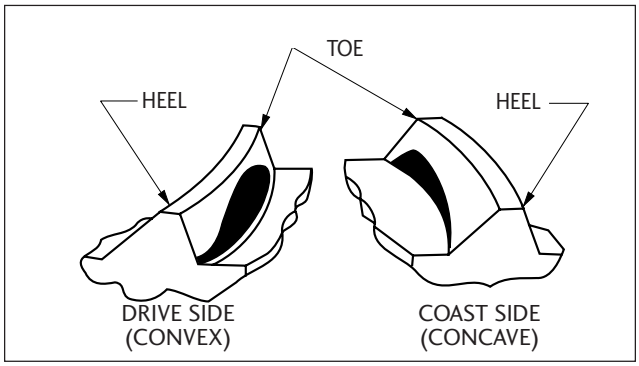


HEAVILY LOADED



INCORRECT GEAR PATTERNS

LIGHTLY LOADED



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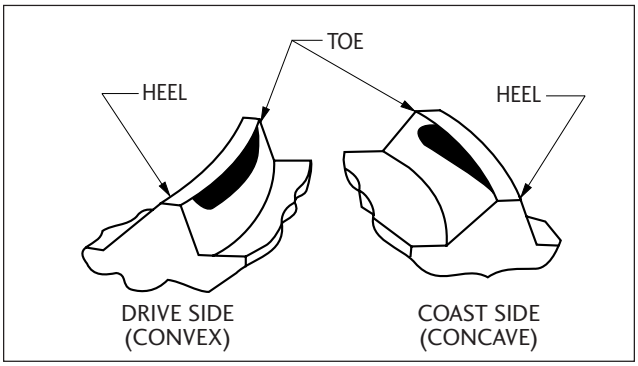


INSTALLATION OF DIFFERENTIAL CARRIER INTO AXLE HOUSING

1. Thoroughly clean the inside of the carrier housing and inspect the housing mounting surface for nicks and general cleanliness. Stone the surface if necessary to remove burrs or nicks. Bolt holes must also be checked, to see that they are free of contaminants.

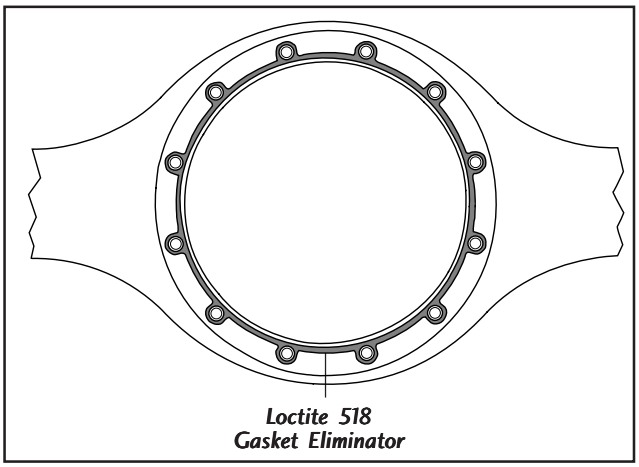


Figure 11

2. Apply an .125 inch (3.175 mm) diameter bead of Loctite 518 gasket eliminator onto the axle housing mounting flange and around each bolt hole. **See Figure 11.**

3. Thread two studs into the axle housing 180^0 apart. This will eliminate rotation of the carrier assembly after it makes contact with the gasket material.

4. Install the carrier assembly into the axle housing. If reinstalling used bolts, clean the mounting bolts, and coat with Loctite #277, and install. Tighten bolts evenly in cross pattern. Torque bolts 240-260 Lb-Ft (325-352 N-m).

5. Allow one hour cure time for gasket material before adding hypoid gear lubricant.

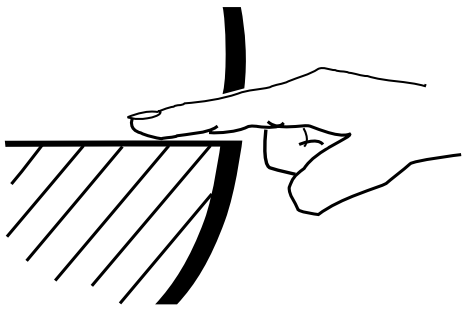
6. Remove the old axle flange gasket and clean mating surfaces of the hub and axle flange.

7. Install the new axle flange gasket.

8. Install the axle shafts to proper location. Torque the axle flange nuts to vehicle manufacturers specifications.

9. Clean drain plug and install. Torque drain plug to 35-45 Lb-Ft (47-61 N-m) Fill unit to proper level with hypoid gear lubricant.

10. Install fill plug and torque to 35-45 Lb-Ft (47-61 N-m).



NOTE : Lubricant close enough to bottom of fill hole to be seen or touched is not sufficient. Lubricant must be level with the fill hole.

CAPACITIES (Approximate*):

Model	Pints	Liters
S230-S/SL	48.8	23.1
S260-SB **	52.9	25.0
S260-SB***	55.2	26.1

** Lube capacity will vary depending upon the housing angle in each vehicle. Capacities given above are for an angle of 4°. Fill to the lower edge of the fill hole in the axle housing as shown above.*

*** Capacity for fabricated housing*

**** Capacity for cast housing*

TORQUE SPECIFICATIONS

S230-S/SL, S260-SB Fasteners

Position	Thread size	Grade	Lb-Ft	N-m
Pinion Hex Nut	1 3/4 – 12		900 - 1,200	1,220 - 1,627
Pinion Bearing Cage Bolts	9/16 – 12	8	160 - 180	217 - 244
Adjusting Ring Lock Bolts	3/8 – 16	8	20 - 30	27 - 41
Carrier Mounting Bolts	5/8 – 11	8	240 - 260	325 - 352
Differential Bearing Cap Bolts	3/4 – 10	8	295 - 340	397 - 460
Differential Case Bolts	9/16 – 12	8	160 - 180	217 - 244
Fill Plug	3/4 – 14		35 - 45	47 - 61
Drain Plug	3/4 – 14		35 - 45	47 - 61
Temperature Sensor Plug	3/4 – 14		35 - 45	47 - 61
Air Shift Cylinder Bolt	3/8 – 16	8	30 - 40	41 - 54
Air Shift Cylinder Plug	1/4 – 18		20 - 30	27 - 41
Electric Switch Unit	9/16 – 18		20 - 30	27 - 41

NOTE: *Refer to vehicle manufacturer specifications for axle Flange-Wheel Nut fastener torque.*

S230-S/SL, S260-SB Specifications

Position	U.S.	Metric
Pinion		
Nominal Dimension	4.5945 in.	116.700 mm
Bearing Preload (Torque Wrench)*	10 - 40 Lb-in	1.1 - 4.5 N-m
Bearing Preload (Pull Scale)*	3 - 9 Lbs.	1.4 - 4.5 Kg.
Differential		
Ring Gear to Pinion Backlash	.012 - .016 in.	.30 - .40 mm
Ring Gear Rivet Pressure	45 - 50 tons	41 - 45 tonnes
Lubrication (Approx.**)		
S230-S/SL Lube capacity	48.8 Pts.	23.1 Liters
S260-SB Fabricated Housing Lube Capacity	52.9 Pts.	25.0 Liters
S260-SB Cast Housing Lube Capacity	55.2 Pts.	26.1 Liters

* *Pinion bearing preload is established prior to installation of pinion seal.*

** *Capacity will vary depending on the housing angle in each vehicle. Fill to lower edge of fill hole in rear of axle housing as shown on Page 22.*

ALL SERVICE TOOLS AVAILABLE FROM OTC DIVISION:

Service Tools
655 Eisenhower Drive
Owatonna, MN 55060
Telephone: 1-800-533-0492
Fax Number: 507-455-7011

DRIVER CONTROLLED DIFFERENTIAL LOCK

INTRODUCTION

The Spicer driver-controlled differential lock provides exceptional traction and pulling power in both slippery driving conditions and heavy-duty applications. Such applications include: pulling double trailers, construction, and refuse collection. In adverse road conditions, the Spicer driver-controlled differential lock also protects against spin-out and shock loading.

The differential lock is activated by a cab-mounted switch. The lock operates through an air-actuated shift assembly that is located on the right-side of the differential carrier. When the differential lock is engaged, an air-actuated piston moves the clutch collar along splines of the axle shaft onto mated splines of the differential case. **See Figure 12.**

When the differential case and clutch collar splines are engaged, the wheel differential is positively locked. The shift fork trips an electric switch unit that signals a cab indiactor light for driver verification. There is no differential action between the rear drive wheels of the axle when the differential is positively locked, resulting in maximum traction to the rear drive wheels. Normal differential action occurs between the rear drive wheels of the axle when the differential lock is disengaged. The cab-mounted indicator light should be off at this time.

DIFFERENTIAL LOCK IDENTIFICATION

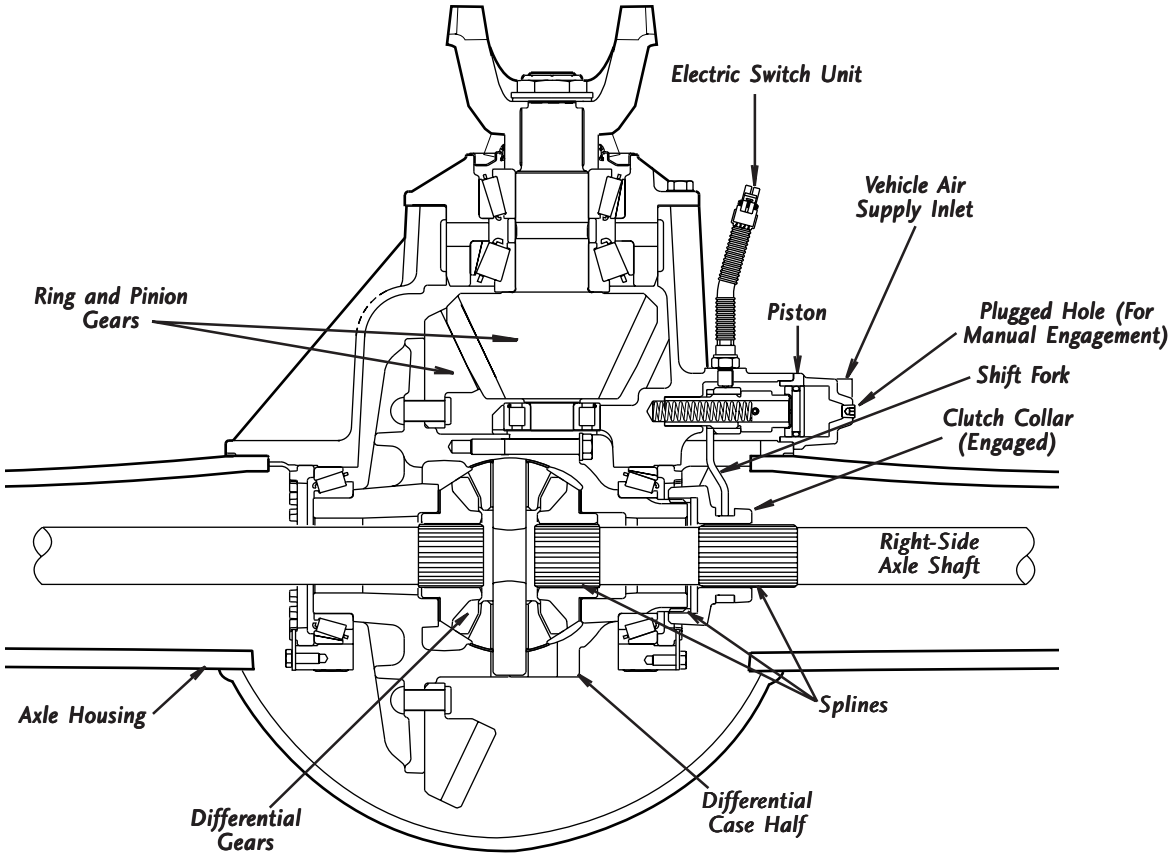
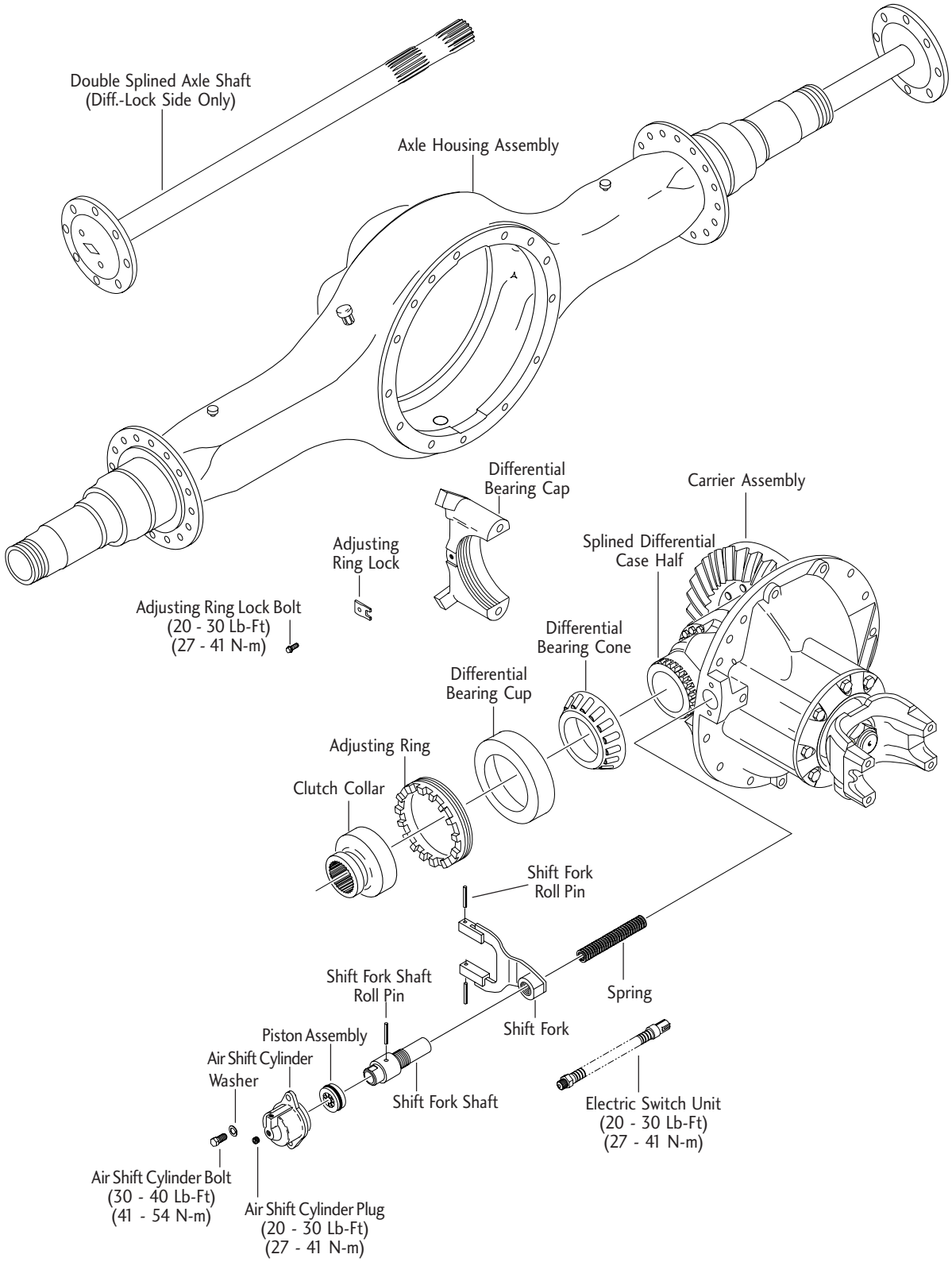


Figure 12

DRIVER CONTROLLED DIFFERENTIAL LOCK COMPONENTS



REMOVE AXLE SHAFTS BEFORE TOWING

If the vehicle is to be towed with the rear axle drive wheels on the ground, axle shafts must be removed. To remove axle shafts use the following procedures:

1. Disengage main differential lock.

NOTE: Differential lock cab light should be off. This indicates that the difflock is disengaged.

2. Remove both axle shafts from vehicle by normal procedures.

NOTE: Right-side axle shaft has two sets of splines: one for the differential side gear and the other for the differential lock clutch collar.

3. Cover both open axle hubs to prevent contaminants from entering axle and loss of any lubricants.

INSTALL AXLE SHAFTS AFTER TOWING

1. Remove hub covers from axle.
2. With differential lock in disengaged position, Install right-side axle shaft.

Due to engaging two sets of splines this axle shaft will need more attention than the conventional axle shaft. Install right-side axle shaft using the following procedures:

- Push axle shaft into housing until contact is made with the clutch collar.
- Rotate axle shaft while pushing down on flange until splines align.
- Push axle shaft further until contact is made with with differential side gear.
- Rotate shaft again while pushing down on flange until splines align.
- Push axle shaft into housing until flange seats against the axle hub.

3. Install left side axle shaft into housing using normal procedures.
4. Fasten both axle shafts to the hubs and torque to vehicle specifications. **See Figure 13.**

RIGHT-SIDE AXLE SHAFT OF DIFFERENTIAL LOCK

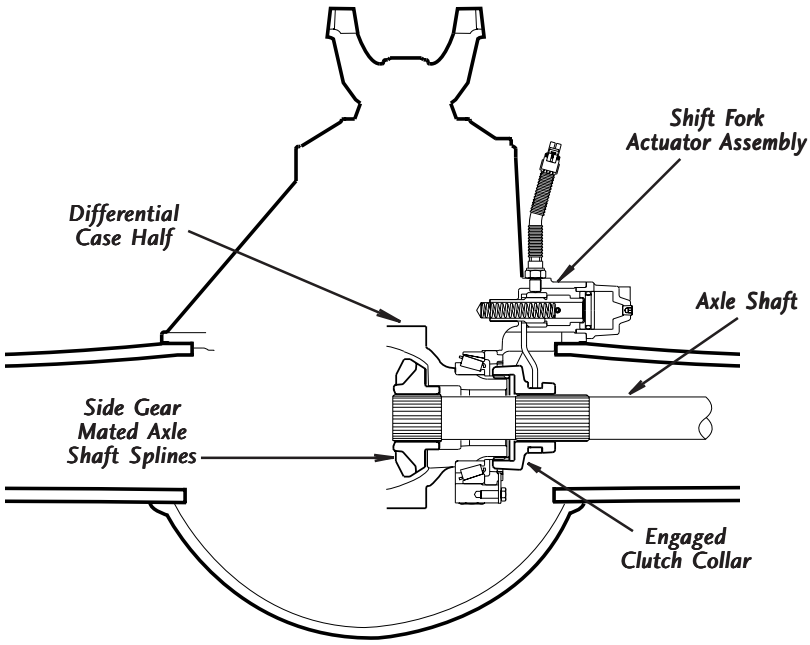


Figure 13

CARRIER REMOVAL

CARRIER REMOVAL

Before carrier assembly can be removed from the axle housing, the main differential lock must be engaged (in the locked position). This must be done before the right-side axle shaft is removed. Engaging (locking) the main differential allows enough clearance for the clutch collar to clear the carrier-to-housing mounting flange so removal can be achieved.

NOTE: Locking of the main differential must be done before removing the right-side axle shaft. If the right-side axle shaft was removed for towing purposes, reinstall it into the housing using procedure 2. from the "Install Axle Shafts After Towing". Page 26.

AIR PRESSURE METHOD

1. Drain lubricant from the axle assembly.
2. Raise the right-side rear drive wheel off the floor using a hoist or jack.
3. Hold the right-side of the vehicle in the raised position by using a jack stand under the right-side housing spring seat.
4. Disconnect the drive shaft from the input yoke.
5. Disconnect air line from the differential lock shift cylinder.
6. Connect an auxiliary air supply to the differential lock shift cylinder.

NOTE: If an auxiliary air supply is not available continue to use the "Manual Engaging Method" to lock the main differntial.

7. Apply and hold air pressure to the shift cylinder. This will move the clutch collar inward and engage splines with the differential case splines, locking the assembly.
8. To ensure differential clutch collar and case half have engaged completely, rotate the drive pinion or the right-side wheel.

NOTE: Continue to keep differential lock engaged (locked) with air pressure until carrier has been completely removed from the axle housing.

9. Remove the axle shafts and carrier assembly from the axle housing using the procedures as shown on Page 8.
10. When carrier has been removed from the axle housing, remove auxiliary pressure from the shift cylinder.

MANUAL ENGAGING METHOD

NOTE: Use this method if auxiliary air is unavailabe.

1. Follow air pressure engagemant method through step 5.

NOTE: Refer to Figure 14 for the following steps.

DIFFERENTIAL LOCK
MANUAL ENGAGEMENT DIAGRAM

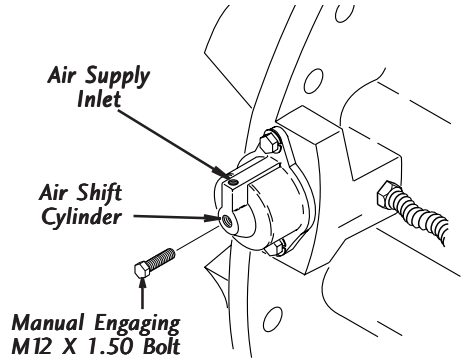


Figure 14

2. Remove plug from the hole in the center of the shift cylinder cover.
3. Install an M12 x 1.50 bolt in the cylinder air-port, same hole the plug was in, to manually engage the differential.

Continued On Next Page

NOTE: Bolt must be at least 1.75 in. long to fully engage differential.

IMPORTANT: Hand tighten the M12 x 1.50 bolt with a socket. See Figure 17 on Page 30.

⚠ CAUTION: If a high resistance to turn is felt before full engagement of lock, stop turning bolt. Over-torquing may cause damage to the shift unit.

4. To ensure lock is fully engaged, rotate the drive pinion or the right-side wheel.
5. Remove axle shafts by normal removal procedures.
6. Remove carrier assembly from axle housing.

Carrier Removal Complete

REMOVAL OF DIFF-LOCK ASSEMBLY

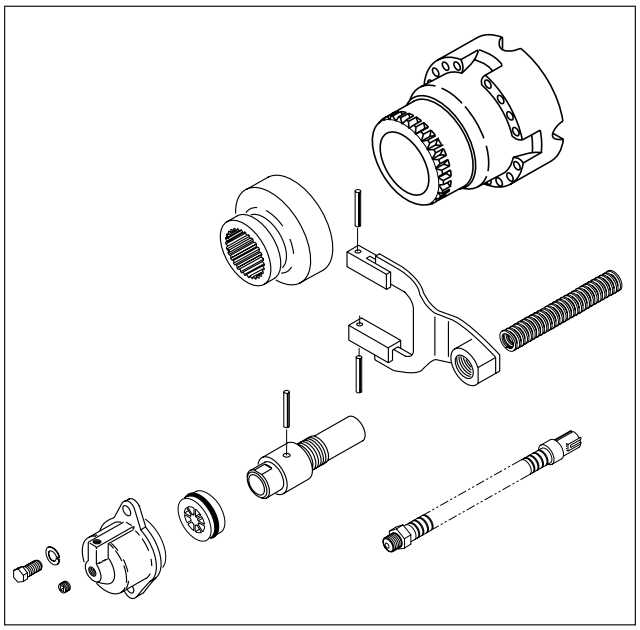


Figure 15

NOTE: The carrier should already be removed from the vehicle before proceeding with the disassembly of the diff-lock components. See Figure 15.

1. Remove the electric switch unit from the carrier.
2. Remove the bolts and washers from the air shift cylinder.
3. Remove air shift cylinder.
4. Remove the shift shaft and shift fork by unthreading the shaft.
5. Remove compression spring.
6. Remove the shift fork and clutch collar from the carrier.

Diff-Lock Removal Complete

INSTALLATION OF DIFF-LOCK ASSEMBLY

1. Place the arms of the shift fork over the clutch collar so that the threaded end of the fork faces the direction shown in **Figure 15**.
2. Position the shift fork collar assembly into the carrier so the collar fits over the splined differential case.
3. While holding the collar in place insert the spring into the shift shaft and thread the shaft into the shift fork. Torque the shift shaft 20-30 Lb-Ft (27-41 N-m).
4. Lubricate the O-ring of the shift piston and install into the shift cylinder. (Install the piston so that the metal spacer is visible. This area will fit over the shift shaft.)
5. Clean the mating surfaces of the carrier shift cylinder and apply a .125 in. (3.175 mm) continuous bead of Loctite 518 to the carrier surface. **See Figure 16.**
6. Install the shift cylinder into the carrier. Do not allow the cylinder to rotate once it has been seated.
7. Install the two shift cylinder washers and bolts and torque 30-40 Lb-Ft (41-54 N-m).
8. Install the threaded plug into the center of the shift cylinder an torque 20-30 Lb-Ft (27-41 N-m).
9. Thread the electric switch unit into the top of the carrier and torque 20-30 Lb-Ft (27-41 N-m).
10. Install the air coupler into the air port.

Diff-Lock Installation Complete

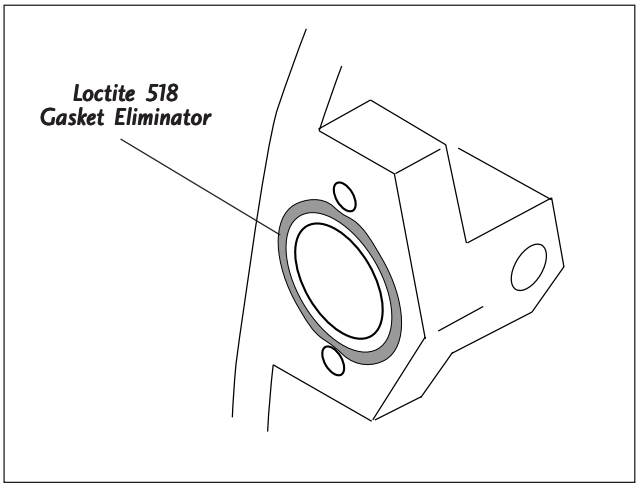


Figure 16

AIR PRESSURE METHOD

1. Install the right-side axle shaft through the clutch collar and into the differential side gear of the carrier assembly. The axle shaft is used to align splines of the the differential case half and clutch collar.
2. Rotate right-side axle shaft until splines of clutch collar and the differential case half are aligned.

⚠ CAUTION: Do not use hands to position shift collar while air pressure is being applied to shift cylinder, injury could result.

3. Connect auxiliary air supply to shift cylinder.
4. Apply and hold air pressure to the shift cylinder. Applying air will move the shift collar inward and engage the splines with the differential case splines locking the assembly.
5. To ensure the clutch collar and differential case splines have engaged completely, rotate right-side axle shaft. When fully engaged remove shaft from the carrier assembly.

IMPORTANT: Hold air pressure on locked carrier assembly until it has been completely installed into axle housing.

6. Install carrier assembly into axle housing and fasten using normal installation procedures.
7. Remove auxiliary air supply from shift assembly and connect the vehicle air line to shift cylinder.
8. Install axle shafts into housing. Use procedures 2 and 3 from the **"Install Axle Shafts After Towing"** section.
9. Remove jack stands from vehicle and lower to shop floor.

MANUAL ENGAGING METHOD

1. Align the splines of the clutch collar and the differential case by hand.
2. Install a M12 X 1.50 bolt into the shift cylinder air-port to manually engage the lock.

IMPORTANT: Hand tighten M12 X 1.50 bolt with a socket. See Figure 17.

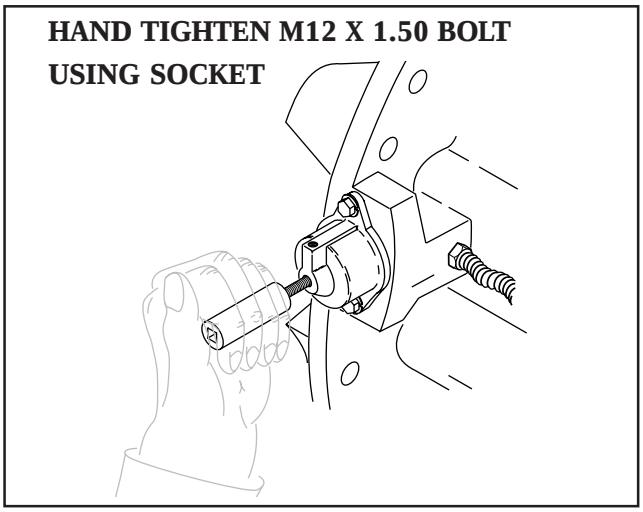


Figure 17

⚠ CAUTION: If a high resistance to turn is felt before full engagement of lock, stop turning the bolt. Over-torquing may cause damage to the shift unit. Realign splines and continue to tighten.

3. To ensure lock is fully engaged, rotate the drive pinion.
4. Install carrier assembly into axle housing and fasten using normal procedures.
5. Remove manual engaging bolt from shift cylinder, replace with air shift cylinder plug and torque 20-30 Lb-Ft (27-41 N-m).
6. Connect the vehicle air line to the shift cylinder assembly.
7. Install axle shafts into the axle housing. Use procedures 2 and 3 from the "**Install Axle Shafts After Towing**" section, page 26.
8. Remove jack stands from under vehicle and lower to shop floor.

Carrier installation complete

CHECKING DIFFERENTIAL LOCK OPERATION

IMPORTANT: Before testing differential lock operation, vehicle must be lowered completely to floor and clear of all obstacles (jack stands, hoist, tools, etc.).

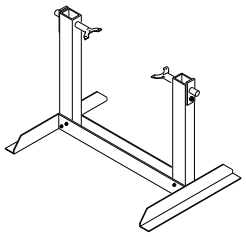
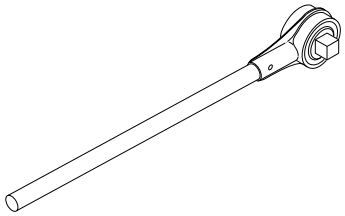
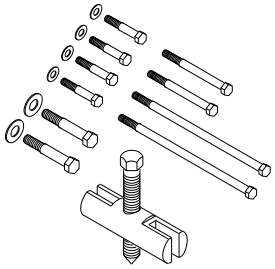
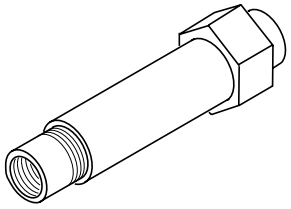
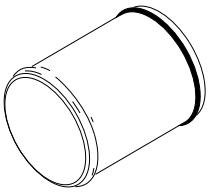
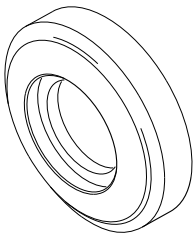
1. Start engine and allow air pressure system to build up to normal operating level.
2. Place cab differential lock switch in the unlocked (disengaged) position.
3. Drive vehicle at very slow speed, (MAX 10 M.P.H.) and check differential lock cab light. The indicator light should be OFF when lock is in the disengaged (unlocked) position.
4. Continue to drive vehicle at low speed (MAX 10 M.P.H.) and flip differential lock cab switch to the engaged (locked) position. The indicator light should now come ON.

IMPORTANT: If indicator light remains on when switch is in the unlocked position, check to see if the manual engaging bolt was removed from the shift cylinder assembly. If engaging bolt remains, remove it and replace with shift cylinder plug. Retest for correct differential lock operation.

NOTE: If differential lock still does not operate in accordance with above tests, check all air and electrical connections. Lastly, if needed, remove carrier by procedures outlined in the "Carrier Removal " section and follow all assembly steps for installation of the carrier into the housing.

Differential Lock Check Complete

RECOMMENDED SERVICE TOOLS

ORDER NUMBER	ILLUSTRATION	DESCRIPTION
DST1001		CARRIER STAND
DST1002 DST1003 DST1004 DST1005		TORQUE MULTIPLIERS Maximum 1,000 Lb-Ft Maximum 2,000 Lb-Ft Maximum 4,000 Lb-Ft Maximum 12,000 Lb-Ft
DST1006		YOKE REMOVER, BAR TYPE
DST1007		INSTALLER, DIFFERENTIAL YOKE (1-3/4"-12)
DST1000-1		SEAL INSTALLATION TUBE HANDLE
DST1000-3		PINION SEAL INSTALLER

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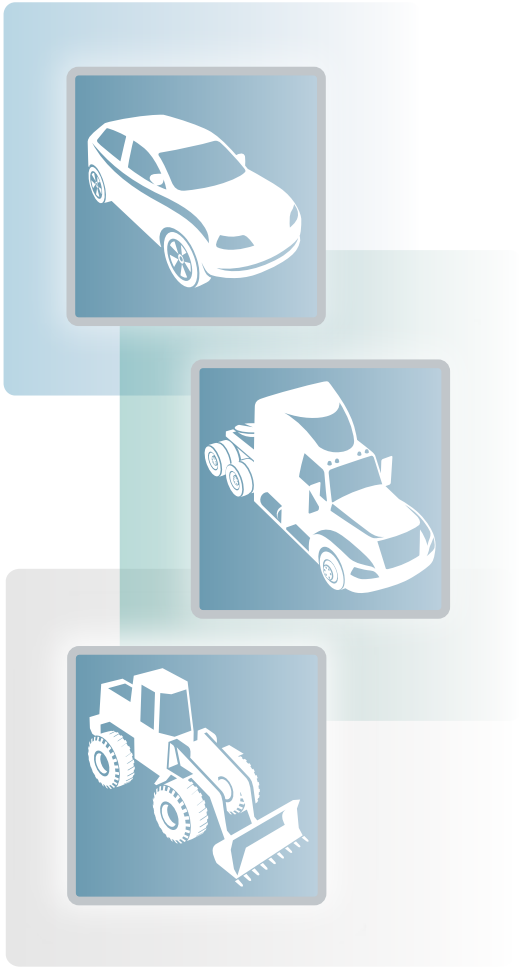

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